Model 9420
AC Power Source

NHR
NH Research

Programmable AC & DC Power with HiVAR®

Key Features

- Voltage Ranges – 175/350VRMS, 200/400VDC

- 7 models – 8kW/21kVA to 96kW/252kVA

- Unique configuration flexibility provides for single, split, three-phase operation plus full-power DC

- HiVAR® design eliminates derating nominal power due to reactive loads

- Frequency – 30 to 880Hz

- High-resolution waveform digitizer & scope display

- Precision ultra-low current measurements

- Seamless, constant-power operating envelope

- Built-in 9" touch-panel user interface for manual control & measurement display

- Graphical waveform editor for user-defined waveforms

- High-level line disturbance programming Macros

- External PC option to host NHR *em*Power® Test Sequencer

- Alternate programming in LabVIEW, native SCPI, & other IVI-compliant languages

- Improved power density results in half the panel height of traditional AC power sources

Model 9420-12 AC Power Source

HiVAR®: More Than Twice the Apparent Power Capability per Kilowatt

The Model 9420 redefines selection of an AC Power Source by addressing how to compensate for reactive power from capacitive or inductive elements in the load. Often overlooked when sizing a source, reactive power negates some portion of nominal VA power in order to arrive at true power (Watts) that does the real work. Traditional AC sources list only their VA rating leaving it up to the user to figure out how much true power remains after reactive power reductions. In many cases that reduction is substantial and then requires selecting a much larger VA-rated source than originally anticipated. The increased cost and size penalties are often considerable.

The Model 9420 AC Source utilizing HiVAR® technology avoids this VA derating penalty by allowing the source to be specified in true power while providing more than twice the reactive power capability for loads with capacitive or inductive elements. To make the AC source selection process more transparent, NHR
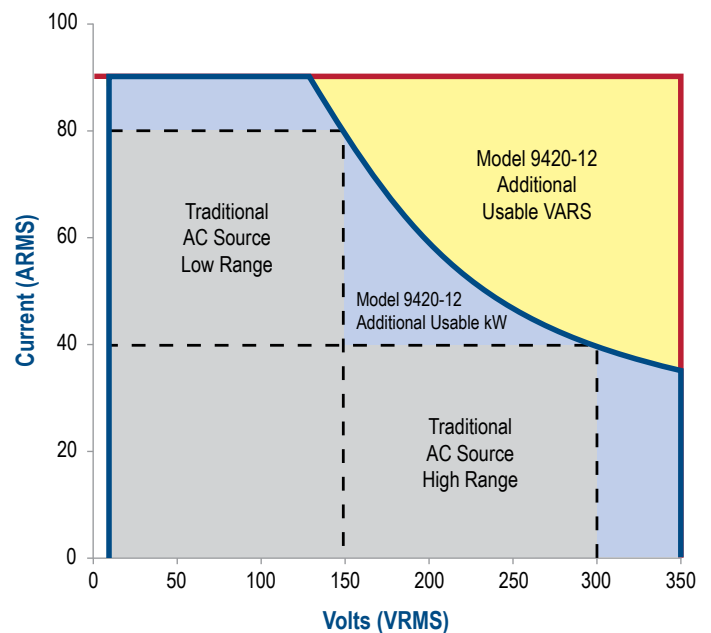

Figure 1 - The Model 9420 12kW in single-phase mode Operating Envelope significantly extends the envelope of similarly sized AC sources especially where reactive power is encountered. Even without reactive power derating, the constant-power envelope results in substantially more useable true power.

list both kW and kVA for each model thereby assuring that an adequately-rated source is considered at the outset.

Exceptional Configuration Flexibility

Independent power modules are the internal building blocks of the Model 9420 AC Power Source that provide unique configuration flexibility. That independence allows each power module to be programmed as all or part of a single-phase, split-phase or three-phase instrument. See Figure 2 for a graphic illustration of this feature. Additional flexibility is provided through the scalability from 8 to 96 kW of power, which allows starting with a source configured for today's power requirements and having the option to add modules in the future should the need ever arise.
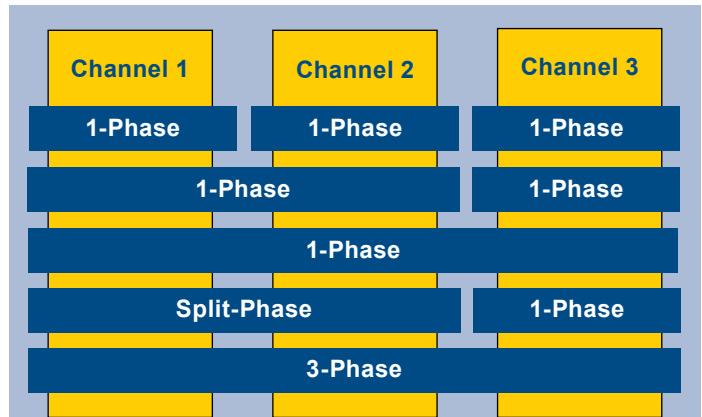

Figure 2 - *Three channels with multiple configuration possibilities.*

Comprehensive Built-In Measurement System

The 9420 AC Power Source includes a built-in measurement system providing the essential power-related measurement functions of a voltage meter, current meter, power analyzer, and oscilloscope. This is accomplished by digitizing voltage and current for each phase in real-time to calculate 35 measurements including a time-stamp at the end of each cycle. Called Background Measurements, these values include the following: AC/DC Voltage and Current, True and Apparent Power, Crest and Power Factor, Frequency and Phase-Angle plus related Peak measurements.

This digitization technique is also used in capturing measurements during a user-specified time window. Called Aperture Measurements, up to 13 common power measurements are captured and available for immediate access. In addition up to 64,000 digitized values are stored, which may be downloaded for further analysis making it possible to derive almost any measurement conceivable. In this manner the 9420 is typically used without any supporting measurement instruments thereby making the test setup simpler and less expensive. In addition, built-in measurements provide a test system that is capable of higher test throughput due to eliminating the switching times necessary to access external measurement instruments.

EnergyStar Measurements

The 9420 AC Source includes 2 precision low-current measurement ranges to measure lightly-loaded, no-load and standby power current draw as required by the many energy efficiency standards. These measurement ranges eliminate the need for additional specialized equipment, routing, and additional test time.

Power Line Disturbance Simulation

The 9420 AC Source is able to simulate power line disturbances through the combination of user-definable waveshapes and Macros. User-defined waveshapes permit generation of non-sinusoidal voltages including asymmetrical inflections, transient anomalies, voltage harmonics (Fig. 3) or any other irregularity which can be drawn as a single cycle. These waveshapes are created through a Graphical Waveshape Editor and downloaded to the Source where they are automatically scaled to the programmed voltage/frequency. Waveshapes may be applied at any phase angle similar to any other programmable setting.

Macros are a pre-programmed sequence of settings where each new setting is present for a sub-cycle, any number of cycles, or for a fixed amount of time. This sequence is entered using a menu-driven, programming-free interface. The sequence is then downloaded to the Source where it is executed to providing precise control of any phase. This combination of user-definable waveshapes and Macros insures the 9420 can simulate notches (Fig. 4), sags/swells (Fig. 5), ramps (Fig. 6), or any other real-world line condition which may be experienced in the field.
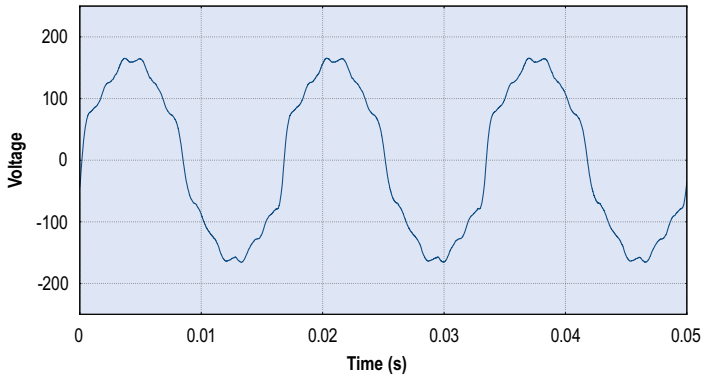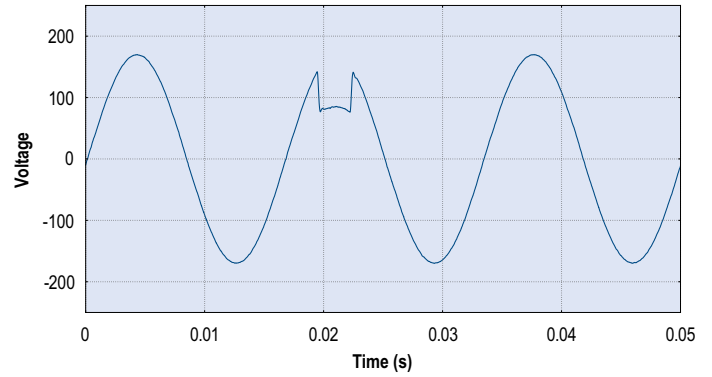
Waveforms

Figure 3 - Voltage harmonics

Figure 4 - Notch
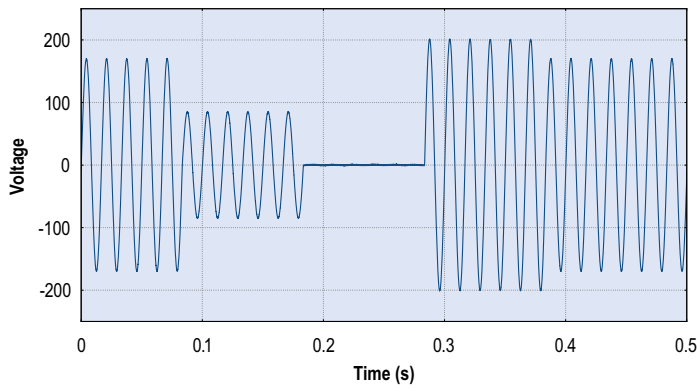
Figure 5 - Sag dropout swell
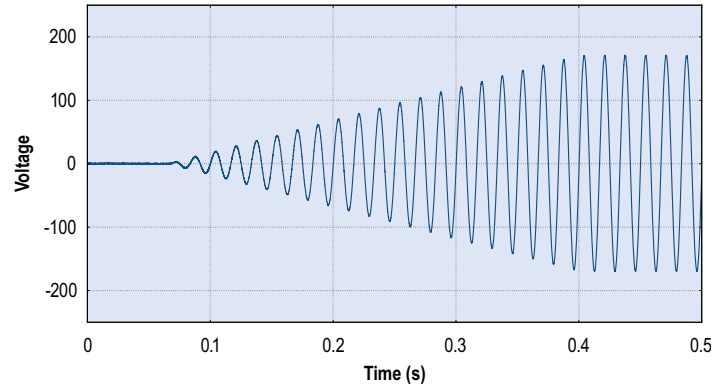
Figure 6 - Ramp

Physical Connections & Controls
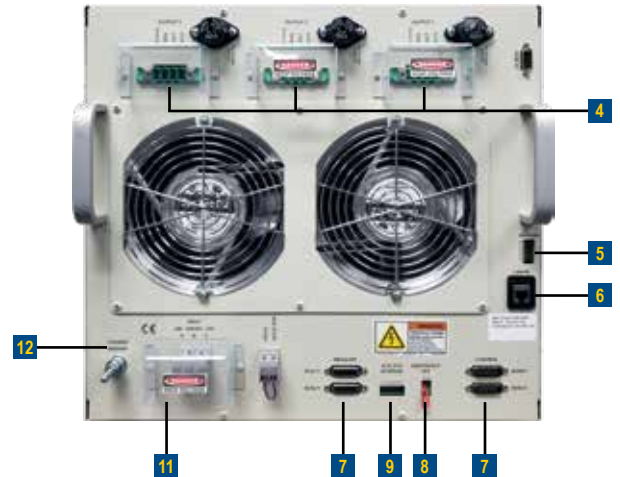
1	Touch Panel Based Control & Display	5	Options Switch	9	Auxiliary Configuration
2	Status Lights & Trigger	6	LAN (Ethernet) Port	10	Safety Interlock
3	Circuit Breakers	7	Parallel Connections	11	Input AC Power Terminal
4	Output Power Connectors & External Sense	8	Remote Emergency Off	12	Chassis Ground

Model 9420 AC Power Source Specifications

MODEL NUMBER	9420-4	9420-8	9420-12	9420-24	9420-36	9420-48	9420-72	9420-96
AC Output Programmability								
Phases/Output Channels	Single	Single, Split-Phase	Single, Split or 3-Phase					
Voltage[1] (LR,HR)	10 - 175, 350VRMS L-N (split-phase limited to 250V max)							
Current Limit Set Ranges[1] (per Φ)	6, 30A (1Φ)	6, 30A (2Φ)	6, 30A (3Φ)	12, 60A (3Φ)	18, 90A (3Φ)	24, 120A (3Φ)	36, 180A (3Φ)	48, 240A (3Φ)
Current Limit Set Max[1] (per Source)	6, 30A (1Φ)	12, 60A (1Φ)	18, 90A (1Φ)	36, 180A (1Φ)	54, 270A (1Φ)	72, 360A (1Φ)	108, 540A (1Φ)	144, 720A (1Φ)
Power Limit Set Max[2] (1, Split, 3Φ)	4kW	8, 8kW	12, 8, 12kW	24, 16, 24kW	36, 24, 36kW	48, 36, 48kW	72, 48, 72kW	96, 64, 96kW
Maximum Apparent Power[2]	10.5kVA	21kVA	31.5kVA	63kVA	94.5kVA	126kVA	189kVA	252kVA
Frequency	30 -880Hz with ± (0.1% Set) Accuracy			Distortion	<1% @ 60Hz (Full power into resistive load at 480VRMS (L-L)/60Hz)			
Peak Current	3 X Max ARMS							
Phase Angle	0 - 359° with 1° Accuracy			Slew Rate	<200µs 10-90% of full scale change to resistive load			
DC Output Programmability								
Voltage Ranges[1] (LR, HR)	10 - 200, 400VDC (< 800mV RMS Ripple)							
Current Limit Set, Max[1] (per Source)	0 - 6, 30A	0 - 12, 60A	0 - 18, 90A	0 - 36, 180A	0 - 54, 270A	0 - 72, 360A	0 - 108, 540A	0 - 144, 720A
Power Limit Set, Max[2] (per Source)	0 - 4kW	0 - 8kW	0 - 12kW	0 - 24kW	0 - 36kW	0 - 48kW	0 - 72kW	0 - 96kW

Measurements

	Range			Accuracy				Resolution
Voltage (LR, HR)	260, 520V Pk							
AC RMS				±(0.1% Rdg + 0.06% Rng) @<100Hz, ±(0.2% Rdg + 0.12% Rng) @>100Hz				0.005% Rng
DC				±(0.1% Rdg + 0.1% Rng)				0.005% Rng
Peak Voltage				±(0.5% Rdg + 0.2% Rng) @<100Hz, ±(1.0% Rdg + 0.4% Rng) @>100Hz				0.005% Rng
Current per Phase (LR, HR)	20, 100A Pk		20, 100A Pk	40, 200 A Pk	60, 300A Pk	80, 400A Pk	120, 600A Pk	160, 800A Pk
AC Current				±(0.1% Rdg + 0.1% Rng) @<100Hz, ±(0.2% Rdg + 0.2% Rng) @>100Hz				0.005% Rng
DC Current				±(0.2% Rdg + 0.1% Rng) High Range, ±(0.2% Rdg + 0.3% Rng) Low Range				0.005% Rng
Peak Current				±(0.5% Rdg + 0.2% Rng) @<100Hz, ±(1.0% Rdg + 0.4% Rng) @>100Hz				0.005% Rng
Power (kW, kVA)	Voltage Range X Current Range			±(0.2% Rdg + 0.1% Rng) @<100Hz, ±(0.2% Rdg + 0.2% Rng) @>100Hz				0.005% Rng
Energy (AH, kWH, kVAH)	Time dependent			0.3% Reading + 0.3% Rng				0.005% Rng
Power Factor	0 to +1.0			±(0.25% Rdg + 0.25% Rng)				0.005% Rng
Crest Factor	1 to 3			±(0.6% Rdg + 0.6% Reading Pk)				0.005% Rng
Ultra-Low Current Measurement	0.1, 1A/Φ		0.1, 1A/Φ	0.2, 2A/Φ	0.3, 3A/Φ	0.4, 4A/Φ	0.6, 6A/Φ	0.8, 8A/Φ
AC Current Accuracy	±1% Range @ < 100Hz, ± 2 % Range @ > 100Hz							
DC Current Accuracy	±1% Range							

Waveform Capture

Data Channels	6 channels (3 phases of voltage and current)	Accuracy/Resolution	0.5% Range/0.005% Range
Bandwidth	DC to 100kHz	Background Measurements	35 total including AC/DC Voltage, Current, True Pwr, Apparent Pwr, Freq., Pwr Factor, Crest Factor, Energy, Phase Angle, Pk V, Pk I, Pk Pwr
Sample Rate	to 125 kSample/sec		
Memory	64k samples for each of 6 channels		
Aperture	1 cycle to 64 sec (longer apertures will reduce the sample rate)	Aperture Measurements	13 total including AC/DC Voltage, Current, True Pwr, plus min/max Pks

Custom Waveforms

Standard	Sine, n-step Sine, Triangle, Clipped Sine, Notched Sine, Arbitrary (User Def.)	User Defined	Graphical wave shape editor or downloaded Excel table

Control

User Interface	No Touch Panel. GUI on PC.	Built-In Touch Panel &/or external PC w/ Windows software tools including GUI	External System Communication	LAN (Ethernet) supporting SCPI or VXI-II
			Drivers	Ni-Compliant LabVIEW Drivers, emPower (opt.), Enerchron (opt.)

Safety

UUT Programmable Limits	V Min/Max, I Max, W Min/Max, each with time delay values	Watchdog	A continuous communication verification program controlled by a test executive
Physical	User Interlock, Emergency Stop & remote e-Stop connection		
Internal Protection	Over-Voltage, Over-Current, Over-Power, Over-Temperature	Self Test	An automatic hardware check upon power-up
Isolation	Facility to Chassis - 1kV, Facility to Output - 2kV, Output to Chassis - 1kV	EMC	CE Mark

Physical

Connectors	Phoenix Contact			Terminal blocks and bus bars				
Form	System Only	Chassis	Chassis	Single Cabinet	Single Cabinet	Single Cabinet	Double Cabinet	Double Cabinet
Dimensions (HxWxD)	5U in S6xx or 5xxx	15¾ x 19 x 28"/ 400 x 483 x 711mm	15¾ x 19 x 28"/ 400 x 483 x 711mm	46x23x30"/ 1168x584x762mm	49x23x30"/ 1981x584x762mm	61x23x30"/ 1981x584x762mm	78x46x30"/ 1981x1168x762mm	78x46x30"/ 1981x1168x762mm
Weight	N/A	150lbs/68kg	155lbs/70kg	480lbs/218kg	640lbs/290kg	780lbs/353kg	1280lbs/581kg	1560lbs/708kg
Operating Temp.	0° - 35°C, Non-Condensing							

Input Power

Voltage	200 - 240 1, 2, 3Φ	Universal Input - 380 to 480VAC ±10% (L-L, 3-Phase, 50/60Hz)						
Frequency	49 - 51Hz or 59.3 - 60.5Hz							
Current/phase @ 380, 400, 480V	15A@208, 25A@200	17, 17, 14A	25, 24, 20A	49, 47, 39A	73, 69, 58A	97, 92, 77A	144, 137, 114A	192, 183, 152A
Efficiency	89 -92% (depending on line voltage) at full power into resistive load at 480VRMS (L-L)/60Hz							
Power Factor @ Full Power	Unity PF > 99% at full power into a resistive load at 480VRMS (L-L)/60Hz							
Cooling	Air Cooled 35°C Max Ambient, reduced power from 35 to 50°C							

Calibration

Method	Closed-cover with standard lab equipment capable of measuring to 0.25 % of device specifications

[1] Programming Accuracies for Voltage and Current are ±(0.2% Set+0.2% Range) @ < 100Hz & ±(0.4% Set+0.4% Range) @ > 100Hz.
[2] Programming Accuracies for Power are ±(0.4% Set+0.4% Range) @ < 100 Hz and ±(0.8% Set+0.8% Range) @ > 100Hz
Note: Accuracies apply when Settings &/or Measurements are greater than 10% of Range. Voltage accuracy applies above 50V.

ORDERING INFORMATION

AC Power Source P/N	9420	kW Rating	-12

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